Neural Network Model for Solidification Temperature Range in Nickel Superalloys Developed

Work is in progress at Oak Ridge National Laboratory on the Welding and Weld Repair of Single Crystal Gas Turbine Alloys.

One of the main objectives of this project is to identify the mechanism for stray grain formation in single crystal nickel-based superalloys. Nucleation of new grains during welding of single crystals is deleterious to weld properties.

One proposed mechanism is constitutional supercooling ahead of the solidification front. A key parameter that is used in identifying the extent of constitutional supercooling is the solidification temperature range. Calculations of the solidification temperature range for numerous nickel superalloy compositions and variations of these compositions were made using computational thermodynamics.

A total of over 600 data points were generated. These data were then used to generate a neural network model that describes the solidification temperature range as a function of alloy composition. This model is fast and convenient to use and bypasses the need to use computational thermodynamics to calculate the solidification temperature ranges.

The model will be used to identify potential composition modifications that will reduce the potential for constitutional supercooling during welding, and will thereby help to avoid stray grain formation during the welding of single crystals.

More about this work.